Claims

What is claimed is:

1. A receiver comprising:

first mixing circuitry adapted to receive a received signal and multiply the received signal by a first local oscillator (LO) signal to provide an intermediate frequency (IF) signal;

second mixing circuitry adapted to receive the IF signal from the first mixing circuitry and multiply the IF signal by a second LO signal to provide an output signal;

a first divider circuit adapted to receive a reference signal from a reference oscillator and divide the reference signal by a first divisor N to provide the first LO signal; and

a second divider circuit adapted to receive the reference signal from the reference oscillator and divide the reference signal by a second divisor M to provide the second LO signal,

the first divisor N and the second divisor M are each integers greater than or equal to one (1) and the second divisor M is not a multiple of the first divisor N.

2. The receiver of claim 1 wherein the second mixing circuitry comprises a quadrature mixer and the first and second divider circuits are further adapted to provide the first and second LO signals as quadrature signals.

3. The receiver of claim 1 wherein a frequency of the reference signal and the first and second divisors N and M are selected such that the second mixing circuitry provides the output signal as a baseband signal.

4. The receiver of claim 1 wherein a frequency of the reference signal and the first and second divisors N and M are selected such that the second mixing circuitry provides the output signal as a very low intermediate frequency (VLIF) signal having a VLIF offset.

5. The receiver of claim 4 wherein the first mixing circuitry comprises a quadrature mixer, the second mixing circuitry comprises a complex mixer, and the first and second divider circuits are further adapted to provide the first and second LO signals as quadrature signals.

6. The receiver of claim 5 further comprising filtering circuitry adapted to receive in-phase and quadrature components of the output signal and reject negative frequencies to provide in-phase and quadrature components of a filtered output signal, wherein the filtering circuitry has a passband centered about the VLIF offset.

7. The receiver of claim 6 further comprising digital signal processing circuitry adapted to digitize the filtered output signal and process a resultant digitized signal to remove static and dynamic DC errors and second order intermodulation distortion components at or near DC.

8. The receiver of claim 7 wherein the digital signal processing circuitry comprises:

conversion and filtering circuitry adapted to digitize the filtered output signal and remove unwanted aliases to provide the digitized signal;

a digital complex mixer adapted to mix an in-phase component and a quadrature component of the digitized signal, thereby converting the digitized signal from the VLIF offset to baseband and converting the static and dynamic DC errors and second order intermodulation distortion at or near DC to the VLIF offset; and

channel filtering circuitry adapted to receive an output of the digital complex mixer and perform low pass filtering, thereby removing the static and dynamic DC errors and second order intermodulation distortion to provide a digital baseband representation of the received signal.

9. The receiver of claim 6 wherein the receiver is a GSM receiver providing at least 50 dB image rejection.

10. The receiver of claim 9 wherein the VLIF offset is at least 175 KHz.

11. The receiver of claim 1 further comprising filtering circuitry between the first and second mixing circuitries, the filtering circuitry adapted to filter the IF signal and provide a filtered IF signal to the second mixing circuitry.

12. The receiver of claim 11 wherein the filtering circuitry comprises a polyphase filter.

13. The receiver of claim 11 wherein the filtering circuitry comprises a bandpass filter.

14. The receiver of claim 11 wherein the filtering circuitry comprises a polyphase filter and a bandpass filter.

15. A receiver comprising:

means for mixing a received signal and a first local oscillator (LO) signal to provide an intermediate frequency (IF) signal;

means for mixing the IF signal and a second LO signal to provide an output signal;

means for dividing a reference signal from a reference oscillator by a first divisor N to provide the first LO signal; and

means for dividing the reference signal by a second divisor M to provide the second LO signal,

the first divisor N and the second divisor M are each integers greater than or equal to one (1) and the second divisor M is not a multiple of the first divisor N.

16. The receiver of claim 15 wherein the means for dividing the reference signal by the first divisor N and the means for dividing the reference signal by the second divisor M are further adapted to provide the first and second LO signals as quadrature signals, further wherein the means for mixing the IF signal and the second LO signal multiplies the first and second LO signals in quadrature.

17. The receiver of claim 15 wherein a frequency of the reference signal and the first and second divisors N and M are selected such that the means for mixing the IF signal and the second LO signal provides the output signal as a baseband signal.

18. The receiver of claim 15 wherein a frequency of the reference signal and the first and second divisors N and M are selected such that the means for mixing the IF signal and the second LO signal provides the output signal as a very low intermediate frequency (VLIF) signal having a VLIF offset.

19. The receiver of claim 18 wherein the means for mixing the received signal and the first LO signal provides the IF signal as a quadrature signal, the means for mixing the IF signal and the second LO signal performs a complex multiplication of the IF signal and the second LO signal, and the means for dividing the reference signal by the first divisor N and the means for dividing the reference signal by the second divisor M are further adapted to provide the first and second LO signals as quadrature signals.

20. The receiver of claim 19 further comprising means for filtering in-phase and quadrature components of the output signal and rejecting negative frequencies to provide in-phase and quadrature components of a filtered output signal, wherein the means for filtering has a passband centered about the VLIF offset.

21. The receiver of claim 20 further comprising means for digitizing the filtered output signal and processing a resultant digitized signal to remove static and dynamic DC errors and second order intermodulation distortion components at or near DC.

22. The receiver of claim 20 further comprising:

means for digitizing the filtered output signal and filtering unwanted aliases to provide a digitized signal;

means for converting the digitized signal from the VLIF offset to baseband and converting the static and dynamic DC errors and second order

intermodulation distortion at or near DC to the VLIF offset to provide a converted digitized signal; and

means for low-pass filtering the converted digitized signal, thereby removing the static and dynamic DC errors and second order intermodulation distortion to provide a digital baseband representation of the received signal.

23. The receiver of claim 20 wherein the receiver is a GSM receiver providing at least 50 dB image rejection.

24. The receiver of claim 23 wherein the VLIF offset is at least 175 KHz.

25. The receiver of claim 15 further comprising a means for filtering adapted to filter the IF signal and provide a filtered IF signal to the means for mixing the IF signal and a second LO signal.

26. The receiver of claim 25 wherein the means for filtering comprises a polyphase filter.

27. The receiver of claim 25 wherein the means for filtering comprises a bandpass filter.

28. The receiver of claim 25 wherein the means for filtering comprises a polyphase filter and a bandpass filter.

29. A method for converting a received signal to a baseband signal comprising:

mixing a received signal and a first local oscillator (LO) signal to provide an intermediate frequency (IF) signal;

mixing the IF signal and a second LO signal to provide an output signal;

dividing a reference signal from a reference oscillator by a first divisor N to provide the first LO signal; and

dividing the reference signal by a second divisor M to provide the second LO signal,

the first divisor N and the second divisor M are each integers greater than or equal to one (1) and the second divisor M is not a multiple of the first divisor N.

30. The method of claim 29 wherein the dividing the reference signal by the first divisor N step and the dividing the reference signal by the second divisor M step further include providing the first and second LO signals as quadrature signals, further wherein the mixing the IF signal and the second LO signal step mixes the first and second LO signals in quadrature.

31. The method of claim 29 wherein a frequency of the reference signal and the first and second divisors N and M are selected such that the mixing the IF signal and the second LO signal step provides the output signal as a baseband signal.

32. The method of claim 29 wherein a frequency of the reference signal and the first and second divisors N and M are selected such that the mixing the IF signal and the second LO signal step provides the output signal as a very low intermediate frequency (VLIF) signal having a VLIF offset.

33. The method of claim 32 wherein the mixing the received signal and the first LO signal step provides the IF signal as a quadrature signal, the mixing the IF signal and the second LO signal step performs a complex multiplication of the IF signal and the second LO signal, and the dividing the reference signal by the first divisor N step and the dividing the reference signal by the second divisor M step are further adapted to provide the first and second LO signals as quadrature signals.

34. The method of claim 33 further comprising filtering in-phase and quadrature components of the output signal and rejecting negative frequencies to provide in-phase and quadrature components of a filtered output signal, wherein the filtering step has a passband centered about the VLIF offset.

35. The method of claim 34 further comprising digitizing the filtered output signal and processing the digitized signal to remove static and dynamic DC errors and second order intermodulation distortion components at or near DC.

36. The method of claim 34 further comprising:

digitizing the filtered output signal and filtering unwanted aliases to provide a digitized signal;

converting the digitized signal from the VLIF offset to baseband and converting the static and dynamic DC errors and second order intermodulation distortion at or near DC to the VLIF offset to provide a converted digitized signal; and

low-pass filtering the converted digitized signal to remove the static and dynamic DC errors and second order intermodulation distortion and provide a digital baseband representation of the received signal.

37. The method of claim 34 wherein the method provides at least 50 dB image rejection.

38. The method of claim 37 wherein the VLIF offset is at least 175 KHz.

39. The method of claim 29 further comprising filtering the IF signal prior to the step of mixing the IF signal and a second LO signal.